USAWC STRATEGY RESEARCH PROJECT

**DETERMINING ATTRIBUTES CONTRIBUTING TO SUCCESS IN
ARMY ADVANCED CIVIL SCHOOLING (ACS)**

by

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ABSTRACT

The Army sends several hundred officers to fully-funded graduate schooling, known officially as Advanced Civil Schooling (ACS), each academic year, and there is a recent emphasis on increasing the number of officers, especially junior officers, attending ACS. This study used regression analysis to identify attributes contributing to success (as defined by program GPA) in the Army and Defense Comptrollership Program Classes of 1998-2005 at Syracuse University, which represent a specialized aspect of ACS where participants follow substantially the same program and earn the same degrees. The study confirmed the validity of the Army's use of several traditional indicators of success (including GMAT score, undergraduate GPA, and relationship of previous undergraduate and/or graduate work to proposed program) in determining which officers should attend such programs. The study also presented evidence providing support for the Army's plans to send an increasing number of officers to ACS earlier in their careers. Finally, the study presented evidence suggesting that family status may impact student performance in certain situations; specifically, that differences may exist between the performance of students without families, students with families accompanying them to school, and students in "geographic bachelor" status, depending upon the nature and/or intensity of the program.

DETERMINING ATTRIBUTES CONTRIBUTING TO SUCCESS IN
ARMY ADVANCED CIVIL SCHOOLING (ACS)

The Army sends several hundred officers to fully-funded graduate schooling, known officially as Advanced Civil Schooling (ACS), each academic year.[1] There is a recent emphasis on increasing the number of officers, especially junior officers, attending fully funded graduate schooling in order to increase the Army's intellectual capital.[2] The Army currently sends officers to as many as 181 different institutions of higher education to pursue masters degrees (in most cases) and/or PhDs.[3] In most cases, these officers attend their respective institutions and pursue specific graduate programs on an individual basis depending on the Army's needs and their career goals.

The primary purpose of the ACS program and other similar full-time educational programs is to "meet the Army's need for commissioned and warrant officers to be educated at the undergraduate and graduate degree levels."[4] While the Army encourages commissioned officers "to obtain an advanced degree in a field related to one of their specialties by taking part in off-duty educational programs,"[5] ACS provides selected officers the opportunity to do so either instead of or in addition to their off-duty studies.[6] Officers who complete ACS programs of 52 weeks duration or longer serve three-year utilization tours in Army Education Requirements System (AERS) validated positions,[7] and incur active duty service obligations of three times the length of the schooling measured in days.[8]

The present study focuses on one of the most unique aspects of ACS within the Army, where a significant number of Army officers and government civilians attend a structured program at the same civilian institution, where they follow substantially the same academic program and earn the same degrees. The Army Comptrollership Program (ACP) was an accelerated, 51-semester hour, MBA program at Syracuse University to which the Army sent officers and civilians for resource management study from 1951 until 2002. In Fall 2002, the newly-designated Defense Comptrollership Program (DCP) expanded to a 60-semester hour program yielding both an MBA from The Martin J. Whitman School of Management, and a Master of Arts in Public Administration (MAPA) from Syracuse's Maxwell School of Citizenship & Public Affairs, in the same 14-month timeframe as the original ACP.

Based on the significant investments involved in these programs, the Army attempts to determine which individuals are best suited for them prior to attendance. Traditional considerations include Graduate Management Admissions Test (GMAT) score, undergraduate grade point average (GPA) and background, previous graduate work, etc. This study uses multiple regression techniques on data from 1998-2005 to determine whether and to what

degree any of 11 available variables can help predict success in the ACP/DCP as measured by GPA in the programs. A key question of this study will be whether the more rigorous DCP has caused significant changes in the predictive power of these variables when compared to those of the ACP.

The information developed from this study will assist Army leaders in determining whether they should change or more rigorously enforce certain prerequisites and/or procedures regarding the DCP, and may also assist prospective DCP students in becoming better qualified for potential DCP attendance and success. It will also have broader application to ACS in general, as the results will be applicable in certain degrees to at least a portion of the larger actual and potential ACS population. In light of the significant investments in human capital that ACS programs represent, as well as the recent initiative to increase and accelerate those investments, it is in the Army's best interest to use whatever means are available in determining which of its people are best suited for ACS attendance. It is equally in the best interests of both the Army and its ACS participants to use whatever means are available to improve, to the greatest degree practicable, those conditions that will lead to greater success in ACS programs.

Background

The present study is a substantial updating and expansion of a project that the present researcher performed (along with another ACP student) as part of their ACP data analysis course during Fall Semester 2000.[9] Because of the course requirement and his interest in this topic, the present researcher contacted the Syracuse School of Management's Director of Army Programs, Colonel (USA Retired) David Berg,[10] and asked for his permission to use the necessary data (described further below). Colonel Berg directed his administrative staff to provide the appropriate data and to work with the original researchers to refine the data as appropriate.[11] The original research resulted in a "final best regression equation model" (explained in more detail below) that found six of the original 11 independent variables studied to be of substantial significance in estimating Syracuse GPAs for the members of the ACP classes of 1998-2000.[12] The present researcher appreciates the contributions of Colonel Berg as well as those of Ms. Terry Placek and Ms. Wilett Bunton, both of the Comptroller Proponency Office, Assistant Secretary of the Army (Financial Management and Comptroller), in making the present study possible and adding to its value.[13]

The importance of the present study has since increased for at least two reasons, neither of which the present researcher could have anticipated in Fall 2000. First, the original ACP program has since become the DCP, and (starting in Fall 2002 for the DCP class of 2003)

expanded from its previous 51-hour, one-degree format to its current, 60-hour two-degree format (more on this below). This obviously puts greater requirements on DCP participants during the same time frame, and therefore adds an additional element of interest and importance to the present study in determining whether and to what degree the changes in the program impact on the attributes contributing to DCP success. Secondly, there has been a recent (Fall 2005) emphasis on the Army sending more officers, especially junior officers, to ACS,[14] and the results of this study bear directly not only on which officers (in terms of qualifications) the Army should send to DCP, but also when (in terms of seniority) the Army should be sending officers to DCP (a consideration that may apply to other ACS opportunities as well).

Some may wonder why it would be important to study specifically how well (in terms of GPA in the Syracuse program) students do, in light of the fact that every one of the 225 students that have attended ACP/DCP in the classes of 1998-2005 has successfully completed the program. While this is true, it has by no means been a foregone conclusion in many cases, as is evidenced by the fact that a few students have finished barely above the B (3.0) average required for graduation.[15] In addition, in a competitive environment where the Army cannot send every student who wishes to attend to DCP (or to other ACS opportunities, for that matter), it is arguably quite important to send individuals who have the best chances of doing well in the program (our concern here) as well as the best potential for future service (the measurement of which is beyond the scope of the present study).

In terms of competition within the program, it has varied widely from year to year.[16] In addition to the designation of an honor graduate, the program provides for the top 20% of each class to receive induction into the prestigious Beta Gamma Sigma International Honor Society. [17] Since these are designations that appear in appropriate evaluation reports, competition for them is sometimes quite intense.[18]

Literature Review

Research literature abounds with examples where researchers have used multiple regression techniques to predict academic performance, as well as other academic phenomena such as college student retention and graduation rates. For example, one 1997 study used stepwise regression analysis to predict GPA changes in medical school based on high school GPAs, admissions test results, assessments by admissions committees, and scores on certain scales of a personality questionnaire. That study resulted in a regression model that "accounted for 32% of the change in grade point average over six semesters of study."[19] A 2002 systematic

review of the literature in this area conducted an analysis of attempts to predict medical school performance based on previous academic performance, personality tests, gender, ethnicity, learning styles, interviews, and personal statements and references.[20] The present study will consider both previous academic performance (based on undergraduate GPA and major and amount and type of previous graduate work, if any) and, at least initially, gender.

Attempts to use regression techniques to predict academic performance apply specifically to MBA studies as well. One 1986 study extended the work of previous researchers in this area by proposing an improved regression model that included undergraduate GPA and major (both of which the present study considers) as well as undergraduate institution.[21] The present study uses scores on the Graduate Management Admissions Test (GMAT) as one potential predictor of success. That is based in part on the fact that studies confirm GMAT scores as valid predictors of MBA performance both in the United States and (though to a lesser degree) in the United Kingdom.[22] Graduate institutions commonly use factors such as GMAT score and undergraduate grade point average in efforts to predict success in management graduate programs. One 1982 study showed that the consideration of just these two items could account for 14% of the difference in grade point averages among students, and that this could improve to 19% when considering specific class groupings.[23]

While the present study is concerned with predicting graduate grade point averages based on other factors such as test scores, there are examples of the logical reverse, where one could use regression to predict college achievement test scores (e.g., the Scholastic Aptitude Test [SAT]) based on such things as high school GPA and IQ score.[24]

In addition to predicting qualitative performance (i.e., grade point average), studies have used regression analysis on measures such as high school grade point averages and college test scores to predict graduation rates.[25] Some have argued that regression techniques would logically be less effective than more advanced statistical methods to study academic phenomena. However, a 1991 study concluded "that despite the theoretical advantages offered by logistic regression and probit analysis, there is little practical difference between either of these two techniques and more traditional linear regression."[26]

Why should certain data elements matter?

In measuring the significance of certain variables in helping to predict Syracuse GPA, we need to have some basis to accept why these significances might matter. Logically, performance is a function of some combination of three broad categories: ability, motivation, and environment. Therefore, we should expect any variable that proves to be a significant

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predictor to be related in some way to one or more of these factors. It may not be possible (and would certainly be beyond the scope of the present study) to determine precisely which variables relate to which combination(s) of these factors. However, it is certainly necessary to discuss at this point some reasonable expectations and conjecture regarding this for the variables under consideration.

Data elements such as GMAT score, undergraduate GPA, amount of previous graduate work, and relation of undergraduate major and/or graduate work to the ACP/DCP curriculum have traditionally served as indicators of potential success in ACP/DCP, and one should certainly not be surprised regarding the possibility that they may prove significant in the models in this study as measures of ability (GMAT score and undergraduate GPA) and environment (for previous college work).[27]

Exact age at start of program and years of experience may be the hardest to classify in this arena. Age is certainly at least an environmental factor, although some might also make a motivational argument (e.g., that either younger or older students might have greater motivation) and/or an ability argument (e.g., that younger or older students might have greater stamina and/or brain function). Likewise, years of experience is also certainly an environment factor, though there is perhaps a stronger argument that those with more relevant experience should do better in ACP/DCP (an ability argument) and/or that those with certain amounts of experience may have greater or lesser motivation.[28]

Regarding differentiation between military and civilians, one would be hard pressed to argue from any objective evidence that there would be differences of ability between these two groups simply because of membership in one or the other. Therefore, any significance regarding this variable should be attributable to some combination of motivation and environment. Since some of the models considered in this study do show significant differences between these groups, this issue will merit further discussion below.

Similarly, one would be hard pressed to argue from objective evidence that there would be differences of ability between males and females simply due to gender difference, and therefore any significance regarding this variable (if present) would be attributable to some combination of motivation and environment.

Consideration of responsibility for dependents and geographic bachelor status provides perhaps the most intriguing element of the present study. The use of indicator variables for these items in this study basically creates three categories: those without responsibility for any dependents, those with responsibility for dependents whose dependents joined them during their time at Syracuse, and those with responsibility for dependents who attended Syracuse in a

geographic bachelor status. There is certainly no objective evidence available within the study to suggest differences of ability attributable to these statuses. However, they are arguably three distinct environmental categories regarding family relations, and one might argue that there could be motivational differences between the groups. This will become important in the discussion below, as these statuses did prove significant in the models.

Finally, the indicator variable used for program cohorts certainly does not (in and of itself) indicate any ability differences. However, it is certainly possible that significant differences in these areas could reflect environmental and/or motivational differences between the groups. The most logical expectation here is that there would be an environmental impact based on the higher requirements of the groups completing 60 semester hours during 14 months (classes of 2003 through 2005) versus the groups that only had to complete 51 semester hours during that period (classes of 1998 through 2002).[29]

Data Elements

This study considers data that measure the following attributes: Syracuse GPA, GMAT score, undergraduate GPA, exact age at start of program, years of experience, amount of previous graduate work, military or civilian status, relationship of undergraduate degree and/or graduate work to the ACP/DCP curriculum, responsibility for dependents, gender, geographic bachelor status, and program cohorts. The endnotes provide more detailed information concerning the definition and development of these data elements.[30] As noted above, previous studies have used several of these or similar attributes (including test scores, previous GPAs, amounts and types of previous graduate and/or undergraduate work, gender, and program cohorts) to predict success in graduate programs, and all of them have been predictive in at least some of the studies in which they have appeared. This study uses several additional data elements (exact age at start of program, years of experience, military or civilian status, responsibility for dependents, and geographic bachelor status) that do not appear in the studies reviewed above, but are readily available for consideration and may or may not prove to be predictive of ACP/DCP performance.

Hypotheses

The research hypotheses for this study include the following:

- Based on the literature review above and the researcher's own previous research, we are likely to find that several of the traditional indicators of success (such as GMAT score, undergraduate GPA, relation of previous undergraduate and/or graduate work to

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current program, and perhaps others) are in fact predictive of success in the ACP/DCP programs.[31]

- Based on the significant additional workload (during the same timeframe) of the double-degree DCP vs. the previous single-degree ACP, we are likely to find that there is a difference in performance between those who were required to complete the double-degree program and those who were only required to complete the single-degree program.[32]

- The researcher further believes that this research may reveal additional information regarding some combinations of environmental and/or motivational factors that will be of value in predicting performance in the ACP and/or DCP.

Research Methodology

The research methodology for the present study will involve attempts to determine which independent attributes are most significant in their potential to help predict success in the DCP and/or ACP by using multiple regression techniques to find one or more "best regression equation models" for both the overall data set and a number of relevant subsets of the data. Comparisons of these models will suggest which of the available attributes have proven most significant over time, as well as whether there are any noticeable trends in changes regarding the significance of certain attributes. Of course, the most significant possibility among such trend changes (and therefore the one on which this study will focus most closely) is whether there are any significant differences between which attributes were most significant between 1998-2002 (when ACP/DCP was a 51-hour, single-degree program) and 2003-2005 (when DCP expanded to a 60-hour, dual-degree program).

In order to retain consistency and allow comparisons between the earlier project and the present study, this study will use most of the same techniques and data programs that the researcher learned to use during the ACP data analysis course in which he conducted the original project in Fall 2000.[33] This involves the manipulation of the data to determine the best models for the relevant data sets and to test those models to ensure that certain possible discrepancies in the data do not unduly detract from their significance.[34]

Construction of Regression Models

The researcher attempted to construct one or more "best regression equation models" for both the overall data set and for two data subsets; specifically, the subsets of cohorts who were only required to pursue one degree (Classes of 1998-2002) and of those who were required to pursue both the MBA and MAPA degrees (Classes of 2003-2005).[35] The endnotes

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contain more information regarding the researcher's reasons for using this procedure, the actual procedures used (a combination of "stepwise regression" and "best subsets regression"), interpretation of the results, and other statistical tests used.[36]

Presentation and Discussion of Best Models

We will begin by using the entire data set (Classes of 1998 through 2005, total of 225 records) and considering all possible variables. After discussing the significance of each model discovered, we will continue by constructing alternative models with certain data elements removed and comparing those models to the ones previously considered. After following this procedure for the complete data set, we will follow the same procedure for the set of classes that only had to complete one degree (Classes of 1998 through 2002, total of 146 records) and then for the classes that were required to complete the double degree program (Classes of 2003 through 2005, 79 records). In each case, the text will show the equation by listing the elements of the equation in the order of their significance to that equation. The accompanying tables show the statistical significance of the data elements for the models as well as the most significant overall statistics for the models.[37]

Models using the entire data set (Classes of 1998 through 2005)

The best initial model using the entire data set and considering all potentially significant variables is as follows:[38]

Model #1 (entire data set with all significant variables)

Syracuse GPA = 2.9
+ 0.00124 (GMAT Score)
+ 0.0654 (if military)
+ 0.0632 (undergraduate GPA)
+ 0.0584 (if undergraduate degree and/or prior graduate work is related to ACP/DCP)
− 0.0444 (if required to pursue double degree)
− 0.00348 (Exact age at start of program)
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(R-Sq = 37.3%; Adjusted R-Sq = 35.6%)

FIGURE 1: MODEL #1

Not surprisingly; GMAT score, undergraduate GPA, and relation of undergraduate major and/or graduate work to ACP/DCP program are positively correlated with Syracuse GPA. Another strong correlation (which is not surprising to the researcher, although it may initially surprise the reader) is the negative correlation between exact age at start of program and

Syracuse GPA (in other words, younger students tend to perform better). This is not surprising as even the youngest students under consideration are fairly close to the age of 30, which many adult education theorists hold is the best time in one's adult life for learning (all other things being equal).[39] We also find that the requirement to complete the nine extra semester hours within the same 14 months (a 17.6% increase in workload) has resulted in lower average Syracuse GPAs for those pursuing the double degree. All of these findings are consistent with the research hypotheses stated above.

Before moving beyond this first model, it is appropriate to determine what, if anything, to make of the fact that the model indicates, with a very high level of significance, that military students have on the whole outperformed their civilian counterparts in ACP/DCP during these years. As mentioned earlier, military and civilian students are subject to similar criteria for selection to attend the program.[40] There is insufficient evidence available to suggest that a difference between military and civilian performance would be a function of differing average ability,[41] nor is there anything available to the researcher to suggest that the environment at Syracuse itself would account for such differences.[42] In fact, most of the significant differences between military and civilian students regarding other variables considered in this study are in the realms of gender and family statuses.[43]

While a detailed argument or attempted proof would be beyond the scope of the present study, the highly significant difference in the performance of military vs. civilians in ACP/DCP suggests (if it is in fact truly significant) a motivational factor; i.e., that military students may, on average, be more highly motivated to perform well in order to compete for honor graduate/top 20% status and/or to make their Academic Evaluation Report (AER) look as good as possible.[44] However, since proving such would be beyond the scope of the present study, we will proceed by considering the next best model available for the entire data set with the military vs. civilian distinction removed:

Model #2 (using entire data set with military vs. civilian data removed)

Syracuse GPA = 3.04
+ 0.00119 (GMAT Score)
– 0.00673 (Exact age at start of program)
+ 0.0674 (Undergraduate GPA)
– 0.0551 (if single with no responsibility for dependents)
+ 0.0474 (if undergraduate degree and/or prior graduate work is related to ACP/DCP)
+ 0.00498 (Years of military and/or Government experience)
– 0.0366 (if required to pursue double degree)

(R-Sq = 37.2%; Adjusted R-Sq = 35.2%)

FIGURE 2: MODEL #2

   As one might expect, we see several variables that remain from the previous model including GMAT score, undergraduate GPA, exact age at start of program, and the difference between the single and double degree cohorts. In fact, two of these variables (undergraduate GPA and exact age at start of program) are more significant in this model than in the previous model. This model also adds two factors now significant at the 95% confidence interval (years of experience and single with no responsibility for dependents). This suggests that over the total period considered here (Classes of 1998 through 2005), those with more relevant experience have had an edge in ACP/DCP performance, and that those with responsibility for dependents have tended to do better than those without such responsibility.

T-/P-Values of:	Model #1 (overall date set)	Model #2 (overall data set)
Constant	23.70/0.000	26.06/0.000
GMAT Score	8.67/0.000	8.18/0.000
Undergraduate GPA	3.03/0.003	3.18/0.002
Military	3.08/0.002	NOT USED
Exact Age at Start of Program	-1.98/0.049	-3.63/0.000
UG Major/Grad Wk Related	2.32/0.021	1.88/0.061
# Years of Govt/Mil Experience	POS NOT SIG	1.87/0.062
Single with No Dependents	NEG NOT SIG	-2.45/0.015
Required to take Double Degree	-2.11/0.036	-1.73/0.085

NOT USED = Data Element was not considered for the model.
POS NOT SIG = Data Element was considered for the model and was positively correlated, but not at a sufficient confidence interval to be used in the model.
NEG NOT SIG = Data Element was considered for the model and was negatively correlated, but not at a sufficient confidence interval to be used in the model.

Item/Model:	Model #1 (overall data set)	Model #2 (overall data set)
R-Sq	37.3%	37.2%
Adjusted R-Sq	35.6%	35.2%
C-p (error)	9.0	9.9
S	0.14508	0.14557
ANOVA F*	21.64	18.36
Pearson*	0.984	0.983
# Unusual**	11	12
% Unusual**	4.89%	5.33%

* ANOVA P -Value and Pearson P -Value were 0.000 for each of these models
** #/% Unusual = Number and percentage of 'unusual observations' in the model (where the Syracuse GPA of a particular student is unusually higher or lower than it should be based on the model's parameters and that student's other data elements)

TABLE 1: T/P VALUES OF DATA ELEMENTS   TABLE 2: OVERALL STATISTICS

   Before moving to consideration of the single vs. dual degree populations, here is a summary of findings from consideration of the models above:

- It is clear that GMAT scores and undergraduate GPAs are consistently, positively predictive of Syracuse GPAs across these classes, and that exact ages at start of program are likewise consistently negatively correlated with Syracuse GPAs. It also appears that exposure to prior work related to the ACP/DCP experience is positively correlated with success in that experience.

- It is clear that the requirement to pursue the dual degree beginning with the class of 2003 has tended to lower average GPAs in the program.

- The models above indicate that performance at Syracuse may also be affected by environmental factors including military vs. civilian status, family status, and/or amounts of military/Government experience.

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Models using either the single degree or double degree data set.

Models using the single degree data set (Classes of 1998 through 2002). The best initial model using the entire data set and all significant variables is as follows:

Model #3 (single degree data with all significant variables)

Syracuse GPA = 2.94
+ 0.00122 (GMAT Score)
+ 0.0623 (Undergraduate GPA)
+ 0.0646 (if student was military)
– 0.0596 (if student was single with no responsibility for dependents)
+ 0.0473 (if undergraduate degree and/or prior graduate work was related to ACP/DCP)
– 0.00337 (Exact age at start of program)

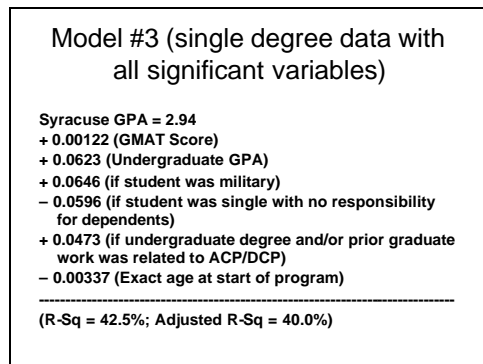
(R-Sq = 42.5%; Adjusted R-Sq = 40.0%)

FIGURE 3: MODEL #3

In this model (as in both of the previous models), GMAT score, undergraduate GPA, and relation of previous college work are positively correlated with Syracuse GPA, while exact age at start of program is negatively correlated with Syracuse GPA. Of note is that, unlike in the previous models for the entire data set, both military vs. civilian status and single with no responsibility for dependents appear in the same model.

We now disregard (as before) the military vs. civilian distinction to yield our second model based on the single degree cohort:
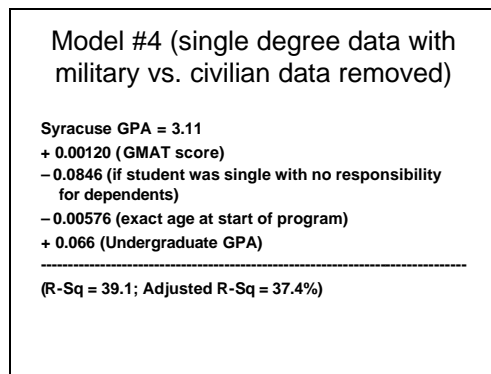
Model #4 (single degree data with military vs. civilian data removed)

Syracuse GPA = 3.11
+ 0.00120 (GMAT score)
– 0.0846 (if student was single with no responsibility for dependents)
– 0.00576 (exact age at start of program)
+ 0.066 (Undergraduate GPA)

(R-Sq = 39.1; Adjusted R-Sq = 37.4%)

FIGURE 4: MODEL #4

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This surprisingly strong model explains 37.4% of the variance in Syracuse GPAs (adjusted R-Sq) by using only four independent variables, all four of which are significant at a 99.4% confidence interval or better.[45] This model also has the lowest C-p (error) score among all possibilities suggested by best subsets regression, and in fact has the lowest error score by far of the three models we have considered based on the single degree cohorts.

T-/P-Values of:	Model #3 (1 degree)	Model #4 (1 degree)	Model #5 (2 degree)
Constant	20.55/0.000	23.43/0.000	17.32/0.000
GMAT Score	7.00/0.000	6.93/0.000	4.57/0.000
Undergraduate GPA	2.66/0.009	2.82/0.006	2.10/0.039
Military	2.43/0.016	NOT USED	NOT USED
Single with No Dependents	-2.20/0.029	-3.29/0.001	NEG NOT SIG
UG Major/Grad Wk Related	1.68/0.095	POS NOT SIG	POS NOT SIG
Exact Age at Start of Program	-1.63/0.104	-3.00/0.003	NEG NOT SIG
Geographic Bachelor	POS NOT SIG	POS NOT SIG	-3.51/0.001

NOT USED = Data Element was not considered for the model.
POS NOT SIG = Data Element was considered for the model and was positively correlated, but not at a sufficient confidence interval to be used in the model.
NEG NOT SIG = Data Element was considered for the model and was negatively correlated, but not at a sufficient confidence interval to be used in the model.

Item/Model:	Model #3 (1 degree)	Model #4 (1 degree)	Model #5 (2 degree)
R-Sq	42.5%	39.1%	35.7%
Adjusted R-Sq	40.0%	37.4%	33.1%
C-p (error)	5.4	3.7	6.9
S	0.13463	0.13750	0.15426
ANOVA F*	17.10	22.66	13.88
Pearson*	0.988	0.989	0.981
# Unusual**	5	5	4
% Unusual**	3.42%	3.42%	5.06%

* ANOVA P-Value and Pearson P-Value were 0.000 for each of these models
** #/% Unusual = Number and percentage of "unusual observations" in the model (where the Syracuse GPA of a particular student is unusually higher or lower than it should be based on the model 's parameters and that student's other data elements)

TABLE 3: T/P VALUES OF DATA ELEMENTS   TABLE 4: OVERALL STATISTICS

Note that in the absence of the consideration of the military vs. civilian distinction, both the difference itself and the significance of the difference between single students with no responsibility for dependents and those in other categories becomes stronger than in any of the previous models. Both that fact and the very high significance of each element in Model #4 in comparison to other models suggest very strongly that the issue of family status is in fact much more significant than is the issue of military vs. civilian status.

Before moving to consideration of the dual degree population, here is a summary of findings from consideration of Models #3 and #4 above for the single degree population:

- There are similar evidences as with the overall population regarding the positive correlations of GMAT scores, undergraduate GPAs, and exposure to prior work related to the ACP/DCP experience to Syracuse GPAs; as well as the negative correlation of exact ages at start of program.

- Models #3 and #4 also suggest, similarly to the earlier models, that performance at Syracuse may also be affected by environmental factors including military vs. civilian status and/or family status. However, unlike those earlier models, none of the models for the single degree cohorts suggest that amount of military and/or Government experience was a significant factor. Further, the exceptional strength of Model #4 when

compared with other models suggests very strongly that family status is a much more significant factor than is military vs. civilian status.

Model using the double degree data set (Classes of 2003 through 2005). The best model using the entire data set and all significant variables is as follows:

```
Model #5 (double degree data with
        all significant variables)

Syracuse GPA = 2.86
+ 0.00109 (GMAT score)
– 0.161 (if student attended Syracuse as a geographic
    bachelor)
+ 0.0835 (Undergraduate GPA)
-------------------------------------------------------------------------------
(R-Sq = 35.7%; Adjusted R-Sq = 33.1%)
```
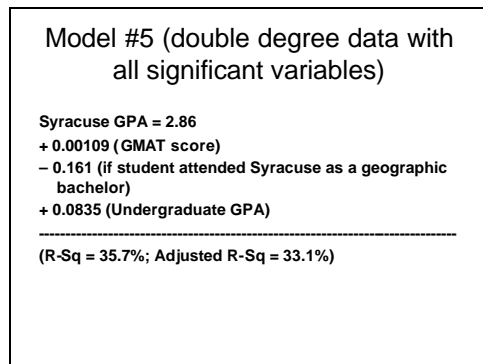
FIGURE 5: MODEL #5

This model explains 33.1% of the variance in Syracuse GPAs (adjusted R-Sq) with only three variables, all three of which are significant at the 95% confidence level. It also has the lowest C-p (error) score among all possibilities from best subsets regression where all variables would be significant at a 95% confidence interval or better.[46]

What is particularly striking about this model is the strong, negative correlation (at a 99.9% confidence level) between geographic bachelor status and Syracuse GPA, as well as the fact that, even though we started with every possible variable, these three variables (and only these three) prove significant at the 95% confidence interval or better.[47]

Before moving to a discussion of the overall implications of these models, here is a summary of observations regarding Model #5:

- As in all of the previous models, GMAT score and undergraduate GPA are strongly and positively correlated with Syracuse GPA. However, unlike many of the previous models, exposure to prior work related to the ACP/DCP experience and exact age at start of program did not enter Model #5.[48]

- Unlike in the overall data and that for the single degree years, the data from the double degree cohort does not indicate any significance regarding military vs. civilian status.[49] The exceptional strength of this model, and in particular the negative correlation between geographic bachelor status and Syracuse GPA, strengthens the assertion that

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family status is far more significant than is military vs. civilian status (if in fact that difference is significant at all).

<u>Discussion of Implications of these Models</u>

Since it appears from the strengths of Models #4 and #5 that family status is more significant that military vs. civilian status, we are left with Models #2, #4, and #5 as the best models for the entire data set, single degree data set, and double degree data set respectively.

The hypotheses for this study indicated that (based on the above literature review and previous research) we expected several traditional indicators of success (such as GMAT score, undergraduate GPA, and relation of previous work to current program) to be predictive of success in ACP/DCP, that we expected a difference in performance between the single- and double-degree programs, and that we might find additional information regarding combinations of environmental and/or motivational factors that might bear on ACP and/or DCP performance. As we will see below, the above-mentioned research results provide support for all three of these hypotheses.

We note that the positive correlations for GMAT score and undergraduate GPA appear in all three of these models. We also note that the negative correlation for exact age at start of program appears in both Model #2 and Model #4, and further note that stepwise regression also suggests the same negative correlation for Model #5 (though it is not significant enough to appear in that particular equation). As far as the other items that are positively correlated and significant in Model #2 (undergraduate degree and/or prior graduate work related to ACP/DCP curriculum and years of military and/or Government experience), the stepwise regressions for both Models #4 and #5 both show the same correlations, though they are not significant enough to justify inclusion in those models.[50] These findings are consistent with the above-cited research and hypotheses regarding the data elements mentioned therein.

This leaves us to deal with the most surprising and significant difference between the single and dual degree cohorts in terms of predictors of success in the respective programs. As mentioned above, the use of the two indicator variable fields allowed us to distinguish between three different populations regarding family status: those who were single with no responsibility for or to dependents when they attended Syracuse, those with families whose families were living with them during their time at Syracuse, and those with families who attended Syracuse in a geographic bachelor status.

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Both the original (Fall 2000) study and the above models regarding the overall data set and the single degree cohorts confirm that those who have attended Syracuse while single with no responsibility for dependents have earned lower average GPAs than those in other categories. This suggests that there was (for the single degree years) an environmental advantage for those who had responsibility for dependents, and that (for the single degree years only) this advantage accrued regardless of whether their dependents accompanied them to Syracuse.

What is most revealing regarding the comparison of the single degree and dual degree years is the significant change regarding geographic bachelor status. Model #5 clearly indicates (at a 99.9% confidence level) that those who have attempted the dual degree have, on average, performed significantly less well at Syracuse than those in other categories (by 0.161 in GPA). This is particularly noteworthy because the stepwise regression for model #4 suggests that geographic bachelor status for the single degree years was actually slightly positively correlated (though at nowhere near a significant enough degree to appear in that model).

Why should family status matter?

As one familiar with traditional graduate study can confirm, the ACP and DCP programs are accelerated in terms of requirements in a given timeframe when compared to traditional MBA (and, for the DCP double degree, MAPA) programs. Even when the program only required one degree within the 14-month timeframe, it yielded a Syracuse MBA that a traditional resident Syracuse student could normally take 24 months to complete. The double degree has increased that already substantially accelerated program by an additional 17.6% increase in workload.[51]

The results above suggest that for the single degree program, those with responsibility to or for families tended to perform better than those without such responsibility, regardless of whether their families accompanied them to Syracuse. However, the increased workload of the double degree program has apparently worked to shift this balance such that those who have attended the double degree program in a geographic bachelor status have performed significantly less well than both those students who have had their dependents with them and those who have not had responsibility for dependents. This suggests that the increased stresses of the program within the same timeframe have resulted in geographic bachelors having to choose between spending limited amounts of time on improved maintenance of family relationships and arrangements and spending that time doing their best in the program.

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There are two broader implications regarding this apparent impact of the double degree program. First, as mentioned earlier, military DCP students are resourced to take their families with them to Syracuse if they desire (since they receive PCS entitlements), while civilians are not similarly resourced (since they usually attend Syracuse in extended TDY status).[52] Of course, some military choose to attend in geographic bachelor status, while some civilians choose to bring their families with them despite being in extended TDY status.[53]

Secondly, prospective students of both DCP and other ACS programs should consider the results of this study as a factor in determining whether to attend their respective programs with or without their families and (in the case of other ACS programs) how heavy their course loads should be during their school attendance.[54] This could also have broader implications for military schools in terms of duration (whether certain schools should be PCS or TDY depending on timeframe, difficulty, and criticality of performance level) and attendance (regarding individual decisions regarding whether to attend a school with or without one's family when options exist).

<u>Recommendations</u>

- Army decision-makers should continue to use indicators of success such as GMAT score, undergraduate GPA, and relationship of previous undergraduate and graduate work to proposed program(s) in screening and deciding which officers should attend DCP and other ACS programs.
- IAW recent stated plans, the Army should send its officers to ACS opportunities at the earliest possible points in their careers consistent with military and other personnel development requirements. In addition to the evidence presented within this study that younger officers tend to perform better in school, these officers will have greater potential to provide the Army with the benefits of the advanced schooling for a longer time, and the opportunity for earlier schooling should also serve (as intended) to enhance officer retention.
- Those advising DCP and other ACS selectees should provide them the appropriate evidence herein so they can use it if they desire in determining whether to attend such opportunities with their families. In addition, the Army's ACS office should be aware of the evidence provided herein as it relates to potential performance of officers in ACS programs based on family status and course load.[55] Finally, proponents of other military schools should be aware of this evidence to as it potentially relates to duration and attendance at these schools based upon their timeframe, difficulty, and/or criticality of performance level.

Conclusion

Army decision-makers have validly used several traditional indicators of potential success in selecting ACP/DCP students.[56] While this research supports their continued use, it has also raised new issues regarding the potential value of sending officers to schooling earlier in their careers, as well as the importance of considering the potential impact of family issues on academic scheduling, preparation, and performance. Because of the significant investment that ACS opportunities represent to the Army, the officer, and the officer's family; the researcher hopes that this research will be of value in determining which officers are best suited for ACS attendance, as well as in potentially improving both academic programs themselves and the conditions under which those participating in them may have the greatest success.

Endnotes

[1] The exact number of officers starting or in ACS at any given time obviously varies:

- Captain(P) Tobias O. Vogt, Chief of ACS, in an e-mail message to the author dated 23 February 2006, indicated that ACS starts each fiscal year (FY) have declined from 612 in FY 1990 to between 324-335 each for FYs 2003-2005. Of course, since most ACS enrollments last longer than 12 months, the total number enrolled at any given time will be higher than starts for a given fiscal year.

- The United States Army's Advanced Civil Schooling (ACS) Home Page, available at https://www.hrc.army.mil/site/active/opfamacs/ACS00.htm; Internet, accessed 12 December 2005, indicates that the ACS office supports approximately 1,600 officers enrolled in schooling each academic year. That total number, however, includes those enrolled in ACS as well as several other programs including the Degree Completion Program, Cooperative Degree Program, Training with Industry Program, and officers who attend graduate school based on outside scholarships or fellowships.

- The ACS office was unable to provide ACS data for years before FY 1990. However, data promulgated by the Army Force Management School in Fort Belvoir, VA indicates that the Army had approximately 7,400 officers enrolled in graduate school each academic year during the mid-1970s.

[2] As evidenced by the following:

- MILPER MESSAGE NUMBER 05-293, AHRC-OPL-L, EXPANDED GRADUATE SCHOOL OPPORTUNITIES FOR JUNIOR OFFICERS, Issued 23 November 2005; available at https://perscomnd04.army.mil/milpermsgs.nsf/ee2966d4436df73a852569a50056935d/9f9dc 3379a853041852570c20052e1c2?OpenDocument; Internet, accessed 12 December 2005.

- Jim Tice, "Army will send more officers to grad school," *Army Times* 66 (19 December 2005), 32-33.

- Multiple senior Army leaders, in their speeches to the Army War College Resident Class of Academic Year 2006, have included specific comments to the effect that the Army either will and/or should increase officer enrollment in ACS. At least one of these leaders specifically commented that some officers should and will attend ACS earlier in their careers. (The researcher will not identify these leaders here due to the College's Non-Attribution Policy.)

[3] FY06 ACS Universities by Cost Categories, link from ACS Program Main Page; available at https://www.hrc.army.mil/site/active/opfamacs/ACS_FY06_University_by_Cost_(23_NOV_05) .xls; Internet, accessed 12 December 2005.

[4] U.S. Department of the Army, *Training of Military Personnel at Civilian Institutions*, Army Regulation 621-1 [hereafter AR 621-1] (Washington, D.C.: U.S. Department of the Army, 20 August 1999), 5.

[5] *Ibid*.

[6] *Ibid*, 5, 8. Paragraph 2-4 on page 8 specifically states that "officers may be considered on a case-by-case basis for a second degree at the same level if the first degree was obtained during off-duty hours or before entry on active duty, or in a different academic discipline, dependent upon the needs of the Army."

[7] *Ibid*, 15.

[8] *Ibid*, 20.

[9] Todd R. Calderwood and Maurice A. Ottinger, "Using Multiple Regression to Predict Syracuse University Grade Point Averages for Army Comptrollership Program Participants," unpublished paper, Syracuse University, Fall 2000 (hereafter Calderwood and Ottinger). This project fulfilled a requirement for that course to perform regression analysis on a dependent variable (GPA in ACP) using a minimum of four independent variables (that project considered 11 such variables, most of which the present study also considers) and a minimum of 30 data sets. The earlier project used data from the ACP Classes of 1998 through 2000, yielding 86 data sets for 86 ACP graduates during those three years.

[10] Colonel Berg's duties with The Martin J. Whitman School of Management at Syracuse University have expanded since that time. His duty title there (as of this writing) is Director of Army Programs and Executive Education.

[11] In the interest of research integrity, it may be appropriate to note here that Lorie Ottinger, the present researcher's spouse, was a member of that staff and did most of the initial work in providing the data for 1998-2000 to then-Majors Calderwood and Ottinger. However, she provided that data only following Colonel Berg's approval and without providing either of the researchers any information from which they could readily tie data to specific subjects.

[12] Calderwood and Ottinger, 2, 10. The present researcher later used the results of this original project, as well as his personal experiences in the ACP, to author an article entitled "Success at Syracuse" (Maurice A. Ottinger, "Success at Syracuse," *Currency Events* [Newsletter of the Greater Atlanta Chapter of the American Society of Military Comptrollers] 1-

10/11 (October/November 2001), 3, 10-11, 13-14, 16). The present researcher received the award for "Best Article" in this publication for Fiscal Year 2002.

[13] The present researcher, in appreciation for the opportunity to use the original data, promised Colonel Berg that at an appropriate future time he would (if provided updated data) update and expand on the research involved to continue and improve the value of this research. The present researcher owes the ability to conduct the present study to his attendance at the Army War College, his faculty/SRP advisor's agreement that the study would be acceptable as an SRP, and Colonel Berg's agreement to provide the necessary updated data. The Army Programs Office provided the data for the ACP/DCP classes of 2001-2005 to the researcher in November 2005, and the researcher added it to the data he had maintained from the original study for the classes of 1998-2000.

The researcher greatly appreciates the contributions of Colonel Berg and Ms. Placek in reviewing the manuscript and providing helpful suggestions. (David Berg, e-mail message to author, 28 February 2006; Terry Placek, e-mail message to author, 2 March 2006.) He also appreciates receiving materials from Ms. Wilett Bunton regarding a recent survey of ACP/DCP graduates and their supervisors (Wilett Bunton, e-mail message to author, 22 December 2005), which provided valuable background information.

[14] MILPER MESSAGE NUMBER 05-293 and Jim Tice, "Army will send more officers to grad school."

[15] The graduate with the lowest GPA in the years studied graduated with a 3.105 GPA in 2001, and there were graduates with GPAs below 3.2 in each of the following three classes. In contrast, the Neuman awardee (honor graduate) in every class except the Class of 2005 has had a GPA well above 3.9, although only three individuals during this time (one in 1999 and two in 2001) have finished the program with a perfect 4.0 GPA.

[16] In at least one ACP year shortly before the period covered in the present study, a 3.76 GPA placed an individual in the top 20% of his ACP class. In contrast, during one year covered in the present study (Class of 2001), the class was so competitive that a 3.90 GPA would have fallen outside the top 25% of the class!

[17] This includes the possibility of more than one Neuman awardee (honor graduate) in cases of exact ties in highest GPA. In addition, the 20% limitation on Beta Gamma Sigma is "rounded up" as necessary, and can include even more individuals in the case of exact ties in GPA among the lowest eligible for the resulting "top 20%" designation.

[18] During the present researcher's June 2000 orientation as a member of the ACP Class of 2001, Colonel Berg specifically stated to that class (as he presumably has to each incoming class) that "At least half of you will obsess about grades." While there is some evidence to support varying levels of competition for grades from year to year, the consideration of specific reasons for such differences is beyond the scope of the present study.

[19] C. Hoschl and J. Kozeny, "Predicting academic performance of medical students: the first three years," *The American Journal of Psychiatry* 154 (1997), 87-92; quote is from abstract available at http://ajp.psychiatryonline.org/cgi/content/abstract/154/6/87; Internet; accessed 16 December 2005.

[20] Eamonn Ferguson, David James, and Laura Madeley, "Factors associated with success in medical school: systematic review of the literature," *British Medical Journal* 324 (2002), 952-957; available at http://bmj.bmjjournals.com/cgi/content/full/324/7343/952; Internet; accessed 16 December 2005.

[21] Richard H. McClure, Charles E. Wells, and Bruce L. Bowerman, "A model of MBA student performance," *Research in Higher Education* 25:2 (June 1986), 182-193; abstract available through http://www.springerlink.com/(qobp0g450wmmmkf5i5ojiwry)/app/home/contribution.asp?referrer=parent&backto=issue,5,7;journal,61,158;linkingpublicationresults,1:401599,1; Internet; accessed 16 December 2005.

[22] Paul Dobson, Pavica Krapljan-Barr, and Carol Vielba, "An Evaluation of the Validity and Fairness of the Graduate Management Admissions Test (GMAT) Used for MBA Selection in a UK Business School," *International Journal of Selection and Assessment* 7:4 (December 1999), 196; abstract available at http://www.blackwell-synergy.com/links/doi/10.1111/1468-2389.00119; Internet; accessed 16 December 2005.

[23] Marion G. Sobol, "GPA, GMAT, and SCALE: A method for quantification of admissions criteria," *Research in Higher Education* 20:1 (March 1984), 77-88; abstract available through http://www.springerlink.com/(uax51tyclhmhsxirzxdk5w45)/app/home/contribution.asp?referrer=parent&backto=issue,6,9;journal,82,158;linkingpublicationresults,1:401599,1; Internet; accessed 16 December 2005.

[24] Richard F. Gunst and R.L. Mason, *Regression Analysis and Its Application: A Data-Oriented Approach* (London: Marcel Dekker, 1980), 8.

[25] Rich Kroc, Doug Woodard, Rich Howard, and Pat Hull, "Predicting Graduation Rates: A Study of Land Grant, Research I and AAU Universities," (Tucson, AZ: Office of Institutional Research and Evaluation, The University of Arizona, n.d.); available online at http://aer.arizona.edu/AER/Enrollment/Policy_Analyses/Predicting%20Grad%20Rates.pdf; Internet; accessed 16 December 2005.

[26] Eric L. Dey and Alexander W. Astin, "Statistical alternatives for studying college student retention: A comparative analysis of logit, probit, and linear regression," *Research in Higher Education* 34:5 (October 1993), 569-581; quote is from abstract available at http://www.springerlink.com/(meyuwnyviyus4s554okjvsiu)/app/home/contribution.asp?referrer=parent&backto=issue,3,7;journal,14,158;linkingpublicationresults,1:401599,1; Internet; accessed 16 December 2005.

[27] Most graduate management schools see GMAT score and undergraduate GPA as indicative of ability to successfully complete a graduate program, although one could argue that these measures, since they are performance indicators themselves, are also based on some combination of ability, motivation, and environment within their own context. Amount of previous graduate work and relation of previous work to ACP/DCP curriculum appear to have more of an environmental nature, since they measure only exposure to these areas rather than specifically measuring performance in them.

[28] One should note that years of experience is arguably one of the least reliable variables considered below, not only because it is student-reported (and not subject to independent

verification) but also because it is less exact than most other variables in the model (being measured only in whole years).

[29] The researcher also explored (but did not include in this paper due to space limitations) whether there were individual class groups that had significantly higher or lower average Syracuse GPAs than other classes. This preliminary research suggested that the classes of 2003 and 2005 (two of the three classes required to pursue the double degree) had lower average Syracuse GPAs than those of the entire data set, while the Class of 2001 had higher average Syracuse GPAs than both those of the entire data set and those who were only required to pursue one degree. This is not surprising when one realizes that the models that do appear in this study show that those required to pursue the double degree had lower average Syracuse GPAs overall than those only required to pursue one degree. Of course, one could argue that differences among individual classes would be attributable to different levels of motivation to excel among the classes themselves, and/or to environmental differences among the classes. However, the ability to research such differences (even if they happened to exist) is beyond the scope of the present study. In addition, an attempt to do so could arguably be subject to undue researcher bias, as the researcher was himself a member of the ACP Class of 2001, and can testify from experience that the competition within that class was quite intense indeed.

[30] Following are details concerning the definition and development of the data elements used in this study:

Syracuse GPA. This is the "dependent variable" (the one the models attempt to predict), while all other data elements below are "independent variables" (data elements that may or may not make it into a model to help predict the dependent variable). Syracuse uses a fairly traditional grading scale where an A = 4.0 quality points, an A-minus = 3.7 points, a B-plus = 3.3 points, a B = 3.0 points, a B-minus = 2.7 points, and so on. The model uses this GPA to three decimal places (e.g., 3.456 could be a person's GPA), and this data came from the Army Programs Office.

GMAT Score. Decision-makers have traditionally used the GMAT score as one of the primary indicators of which individual applicants should attend both ACP/DCP and other similar programs, usually requiring a minimum score of 500 to allow someone to apply or to consider them competitive. (See the Assistant Secretary of the Army (Financial Management and Comptroller) [ASA(FM&C)] Web Page regarding the DCP, available at http://www.asafm.army.mil/proponency/POWBT/careerdevelopment/dcp.html; Internet; accessed 12 December 2005.) However, both Army and Syracuse University officials have permitted a significant number of students to participate in the ACP or DCP with a GMAT score below 500. The lowest GMAT score for all ACP/DCP students during this period was 350, while the highest was 740. The mean (average) GMAT score was 542.18. The Graduate Management Admissions Council provides basic information regarding the GMAT at its MBA.com web page, available at http://www.mba.com/mba/default; Internet, accessed 12 December 2005. One's GMAT score is a whole number between 200 and 800 (higher is better), although scores above 700 or below 300 are quite rare. It is possible for an individual to have taken the GMAT multiple times. In that case, the GMAT score used in the analysis is the highest score that the Army Programs Office has on file for the person in question.

Undergraduate GPA. This is the undergraduate GPA that the Army Programs Office has on file for an ACP/DCP student, up to three decimal points significance (although they may not

be to that level of detail in all cases). These are based on a 4.0 scale, although undergraduate programs obviously vary regarding their exact grading standards. This is another area that decision-makers traditionally regard highly when they decide which individuals should attend ACP/DCP and other similar programs. The ASA(FM&C) Web Page regarding DCP (see above) indicates that Active Duty and Active Guard and Reserve Army Officers must have a bachelor's degree with a minimum 2.5 undergraduate GPA. Army Civilians are required to have a bachelor's degree, but the web page does not specify a minimum undergraduate GPA requirement for civilians. Undergraduate GPAs among ACP/DCP students in the present study range from a low of 2.0 to a high of 4.11, with a mean (average) of 3.0706.

Exact Age at Start of Program. This is the exact age of a student (in whole years and to four decimal places for a portion of the year) as of 1 June of the year the student started ACP or DCP (e.g., as of 1 June 2000 for the ACP Class of 2001). The researcher calculated these exact ages (for both the original project and current study) based on dates of birth for students provided by the Army Programs Office. Once calculated, the researcher referred only to the exact ages and disregarded the dates of birth, as they would be the most likely way by which one could (either intentionally or inadvertently) tie a specific record to a specific individual. The youngest student in this study was just under 26 ½ years old, the oldest just under 55 ½, with an average age of just over 37. (In the initial stages of the original study, the researchers used only ages in whole years as of 1 June of the year starting the program. Later conversions to exact ages significantly improved the original model.)

Years of Experience. This is a whole number of years of military and/or government experience as of the time the student started ACP or DCP, as reported by the Army Programs Office based on entries students provided for their class biographic books. The minimum years of experience reported were 3, the maximum 31, with a mean (average) of 11.884.

Previous Graduate Work. This is the number of semester hours of previous graduate work (if any, otherwise the number is zero) that an ACP/DCP student has completed prior to ACP/DCP attendance (with any other systems converted to equivalent semester hours). For the original project (Fall 2000), the researchers received this number directly from the Army Programs Office. For the updated data, the present researcher calculated this number for each student from transcript copies provided by data record number (but with student-identifying data blacked out) by the Army Programs Office. The highest number of previous graduate semester hours reported was 112.67; the mean (average) was 8.43. (In the initial stages of the original study, the researchers used only an indicator variable to show whether an individual had performed any graduate work. Later calculations of exact numbers of previous graduate semester hours significantly improved the original model.) This calculation took into account only "graded" graduate work; i.e., the numbers of hours would not include such things as doctoral dissertation progress, audited graduate courses, etc.

Military or Civilian. This variable and the others described below, are what researchers properly call "indicator variables" (and commonly call "dummy variables"), because they assign a value of either 1 (one) or 0 (zero) based on a specific status. For the purpose of this analysis, the researcher assigned a "1" for each active duty military student and a "0" for each civilian student as identified by the Army Programs Office. 58.67% of ACP/DCP students during this period have been active duty military. A person attending ACP/DCP in a civilian capacity is identified as a civilian even if they also hold a military status (e.g., retired or Reserve military), as several have.

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Related Undergraduate Degree and/or Graduate Work. This is an indication of whether the student's undergraduate major and/or any previous graduate work is substantially related to the content of the ACP or DCP program. The researcher made judgment calls for each student on this variable based on information provided by the Army Programs Office. If the researcher determined that the undergraduate major and/or graduate work was related, this variable is a "1;" if not, this variable is a "0." Based on this criterion (which Colonel Berg specifically suggested and which improved the significance of the model in the original study), the present researcher determined that almost 80% of ACP students during this period have had either an undergraduate major and/or prior graduate work related to the subjects taught in ACP/DCP.

Responsibility for Dependents. This is an indication of whether a student had responsibility to or for any dependents during his/her time at Syracuse, as reported by the Army Programs Office. If a student was single with no responsibility to or for any dependents during the ACP/DCP, this variable is a "1," if not, this variable is a "0." 26.67% of ACP/DCP students during this period have been single without responsibility for or to any dependents. Throughout the study, the reader should understand the term "single" in this context to mean "single without responsibility for or to any dependents."

Gender. According to Army Programs Office provided data, the researcher assigned a variable of "1" for males and "0" for females. 74.67% of ACP/DCP students during this period were male.

Geographic Bachelor Status. This is an indication of whether a student attended ACP/DCP in a geographic bachelor status; i.e., leaving a family that might normally be living with him/her in another location during his/her time at Syracuse. Based on data provided by the Army Programs Office, the researcher assigned a "1" to those who were in a geographic bachelor status during all or most of their time at Syracuse and a "0" to all others (including those who had no responsibility for dependents). 14.22% of ACP/DCP students during this period have been in a geographic bachelor status based on this definition. Early in the original study, the researchers used only one indicator variable to show whether someone was at Syracuse with or without a family (i.e., singles and geographic bachelors were in the same category, and those with families at Syracuse were in the other). Later use of the two indicator variables ("single" and "geographic bachelor") to show in essence three categories (since only those with families at Syracuse would be "0" for both categories) significantly improved the original model. (Of course, by simple math one can determine that 59.11% of ACP/DCP students during this period have had families with them during their time at Syracuse.)

Program Cohorts. To see whether there was an overall significant difference between the GPAs of the single degree and dual degree classes, the researcher used an indicator variable field. Those required to pursue the double degree (classes of 2003-2005) had a "1" and those required to pursue only one degree (classes of 1998-2002) had a "0."

[31] Specifically, we expect that GMAT score, undergraduate GPA, and relation of previous work to current program will each be positively correlated (i.e., higher GMAT scores and/or undergraduate GPAs, as well as situations where previous work is related to the current program, should be predictive of higher Syracuse GPAs).

[32] Specifically, we expect that those required to complete the double-degree program are likely to have, on average, lower Syracuse GPAs than those who were only required to complete the single-degree program.

[33] Sources for this information include the following:

- John D. McKenzie, Jr. and Robert Goldmann, *The Student Edition of Minitab for Windows 95 and Windows NT, Release 12* [Softcover book and software program on CD-ROM] (Reading, Massachusetts: Addison Wesley, 1999).

- Harry V. Roberts, *Data Analysis for Managers with Minitab* [Hardcover book and 3.5" disk with data programs] (South San Francisco, CA: The Scientific Press, 1991).

However, there will be at least one important difference between the procedures used in the Fall 2000 course, and those used here, based upon the nature of the data involved. The Syracuse Data Analysis course focused most specifically on "time series data," or data on the same performance entity collected over successive time periods. The data involved in the present study is more accurately described as "cross-sectional data," since it focuses on the performance of different students in the same program (as opposed to, for example, focusing on the performance of the same student or set of students over different terms, which would be more of a time series issue). Even though we were using cross-sectional data in the original study, the professor (because of the course's time-series emphasis) still required us to perform tests on that data as if it were time series data (although he knew there would be no requirement or expectation that the data would necessarily pass those tests). Data testing for the present study will forego certain of those tests (which focus on randomness, which is not the concern here), but will focus even more heavily than in the original study on testing for normality of the results of the regression equations (which is the primary concern for cross-sectional as opposed to time series data). [See Harry V. Roberts, *Data Analysis for Managers with Minitab*, 142-3, 196, 365, 408.] Ironically, the time series tests on the original data set came surprisingly close to passing time series tests. The data sets in the present study would not do so, however, as the researcher has specifically manipulated their order for ease of use in such a way that such tests would clearly identify them as non-random.

[34] Because relatively few SRP writers or readers are familiar with multiple regression techniques, this paper includes footnotes that provide explanation in detail (and in as non-technical language as possible) of the origins and refinement of the current study's data as well as of the procedures the researcher used to determine the best regression models. Those who are either more familiar (or less concerned) with multiple regression techniques and/or the data in question will probably not need to make as many references to these footnotes.

[35] The reason for the designation of the earlier cohort as only being "required" to pursue one degree is because there have been occasional provisions for ACP students (prior to the requirement to pursue the dual degree) to be allowed to begin work on the MAPA on their own initiative during their ACP MBA studies. However, the Army Programs Office, while always identifying this as an option, never specifically encouraged it, and only those with exceptional academic qualifications were usually permitted to pursue this option. Furthermore, it does not appear to have impacted the significance of the differences between the single- and dual-degree cohorts (although if anything, one would expect it to have lessened them).

[36] The logic of constructing only these models as opposed to several other possibilities stems from several considerations. First, a significant research question for this study is whether there have been any significant changes regarding which variables most help to predict success in the programs, and study of the overall data set clearly shows that there is a

significant difference (as one might logically expect) between the overall performance of the dual-degree subset and that of the subset that was only required to pursue one degree.

Secondly, it is logically far more important, in terms of assessing potential for future DCP attendees, to focus on trends over time as opposed to the performance of single year ACP or DCP cohorts or smaller groups, particularly those further removed from the present. There is also the problem where regression analysis of smaller data sets is more likely to either result in illogical conclusions or violate the assumptions upon which regression analysis is based. (Hence the original study's requirement to consider at least 30 data sets, although many ACP/DCP classes have had fewer than 30 students.) Attempts to perform regression analysis on these smaller data sets from individual years would, in some cases, result in illogical and unsupportable conclusions, such as (for example) assertions that exposure to prior graduate work would actually place a person at a <u>disadvantage</u> vs. someone who had never pursued prior graduate work!

The study of trends over longer periods of time is more likely to result in identification of those few independent variables that are truly significant in helping to predict successful performance, which is the primary research goal for this study. The downside of studying these larger data sets, however, is that it tends to lower the overall predictive power of the resulting model, since there will be more variation for which the model will not be able to account. In short, while this research (like most similar research described in the early part of the paper) will be of value in identifying some of the most significant attributes contributing to success in ACP and/or DCP, it will be of lesser value in constructing a model that one would want to use to precisely predict what one's GPA in a future DCP class is likely to be based upon a given set of variables.

The researcher used a combination of procedures known as "best subsets regression" and "stepwise regression" to construct models that he believes use the most appropriate combinations of independent variables to explain as much of the variation in Syracuse GPAs as possible. Best subsets regression allows the MINITAB program to look at a group of independent variables and present statistics to the researcher explaining what percentages of the variance in GPAs would be explained by various combinations of independent variables, as well as explaining the relative amount of error that each such model would contain. (In statistical language, it provides the R-Square, Adjusted R-Square, C-p, and s scores for each combination.)

Stepwise regression constructs outlines of possible models by bringing each possible variable into the model in the order in which it potentially contributes to explaining the differences in GPAs. Using these tools in combination, the goal is to construct one or more models that explain as much of the variance as possible, using as few variables as possible, each of which is as highly significant as possible, with the lowest overall remaining error possible. A key reason for restricting the number of variables is that in most cases, almost all variables will have some amount of positive or negative correlation. Using these criteria helps to ensure that, in a given situation, only those variables that are most likely to be truly significant are included in a model.

The result of these procedures is the construction of a regression equation that predicts Syracuse GPA through a formula that starts with a constant number and then adds or subtracts different amounts based on the values of the independent variables contained in the equation. Each variable has both a multiplier (indicating how large a difference in the equation it

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represents) and a "T-value" and "P-value" that show in broad terms how significant that variable is to the overall equation model. Generally, the combination of T-value (the higher the better) and especially the P-value (the lower the better) give a "confidence interval" that indicates how sure one can be that the variable is significant in predicting the Syracuse GPA as part of that model. For example, statistically speaking, if the P-value is zero, one can have the highest possible confidence of the significance of that variable within that model, whereas if the P-value is 0.05, one can be 95% sure that the variable is significant (as opposed to a 5% chance that the variable only falsely appears to be significant). In constructing models of this nature, researchers generally shoot for at least a 95% confidence interval in each variable when possible, although there are certain instances where the "best" model could have certain variables that are only significant at somewhere around the 90%-94% level. As those familiar with regression procedures know, the "best" model can sometimes be a hard choice among several that appear equally good (or not so good) and can be a subject of considerable debate even among seasoned statisticians.

Another issue that regression researchers must consider is that of ensuring that the presence of multiple variables that are highly correlated with each other does not invalidate the significance of a model which considers them in combination. This is one of the reasons that the researcher added the use of best subsets regression to the original plan to use stepwise regression (the only method used in the original Fall 2000 study on the ACP Classes of 1998 through 2000). Best subsets regression (using MINITAB) will refuse to provide possible models if the program detects that any of the variables under consideration are too highly correlated with each other.

While there are several other statistical tests that can detect obvious problems in this area (which the researcher has performed on all models described here), there are certain cases where it can be impossible to absolutely confirm whether variables are improperly correlated. This is part of the reason that this study will consider multiple possible "best models," some of which will remove certain variables that may have this problem (or that critics of such research might suspect would have this problem) so that the reader can see which other variables become or remain significant in their absence. The researcher continued this process for each category (the overall data set and two data subsets as described above) until the removal of further variables would have resulted in models that were clearly inferior to those presented.

Providing documentation of many of the statistical procedures used to develop the models that the researcher presents and describes in the paper within the paper itself is not practical due to space limitations. For each model, the researcher created printouts of both the stepwise regression and best subsets matrices, as well as of the regression analysis results and key statistical tests. These tests included in each case a plot of fits to residuals (confirming randomness) and a plot of normalized scores to residuals (which should be as close to a straight line as possible but will never be perfectly straight) showing the goodness of fit of the model. They also included histograms and dotplots of both standardized residuals and normal scores. The histograms and dotplots of standardized residuals should be as close to normally distributed ("bell-shaped curve") as possible, but (just like the plot of normalized scores to residuals) will never be perfectly bell-shaped. However, the histograms and dotplots of normalized scores should be (and were for each model presented herein) normally distributed. Finally, each model included a Pearson correlation between the standardized residuals and normalized scores. This correlation number should be as close to 1.000 (perfect correlation) as possible, though it will never be exactly 1.000. It should also have a corresponding P-Value as close to 0.000 (perfect) as possible, indicating the highest possible confidence in the correlation

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between the standardized residuals and normalized scores. (All models presented herein had a Pearson P-Value of 0.000.)

Another series of important tests that the researcher conducted for these models (but that are not included in this paper due to space limitations) are plots of each significant variable in the model to the standardized residuals of the model. In each case these plots should (and do) show randomness (i.e., the plots themselves do not indicate any patterns that would suggest problems with the significance of the variables).

Those who are interested in seeing more details regarding the statistical tests used and their results may e-mail the researcher at mo.ottinger@us.army.mil.

[37] As mentioned in an earlier note, there are many statistical tests that the researcher performed in developing these models where the detailed results are not available here due to space limitations. Those who are interested in seeing more details than are available here may e-mail the researcher at mo.ottinger@us.army.mil.

[38] Each figure shows a regression equation for a model that predicts Syracuse GPA through a formula that starts with a constant number and then adds or subtracts different amounts based on the multiplication of the variable in question with the number preceding it. In the case of indicator or "dummy" variables, the multiplier is "1" if the condition exists or "0" if it does not.

[39] Calderwood and Ottinger, 7-8.

[40] One key difference, although its effect, if any, is not measurable in the present study, is that all civilian students must interview as part of the selection process, while military students are neither required nor authorized to appear before the boards that select them for attendance (see Attachment 1 to the DCP announcement memo for civilians at http://www.asafm.army.mil/ proponency/POWBT/careerdevelopment/dcp.html, which states this requirement).

[41] To determine where significant differences between military and civilian populations exist in other measurable elements used in this study, the researcher performed two-tailed, two-sample T-tests (without assumption of equal variance) between the military and civilian populations on each of the other data elements. (Traditionally, differences between such groups are only considered statistically significant if they exceed the 95% confidence interval, equating roughly to $T = 2.00$ or higher and $P = 0.05$ or lower.)

Of the 225 students considered in the present study, 82 (56.2%) have been military and 64 (43.8%) have been civilians at the time of their attendance. The only class in the study in which military students did not outnumber civilian students was the Class of 2000, which had an even number of military and civilian students (14 each). Of particular note is the fact that over the timeframe considered in this study, civilian attendance at Syracuse has tended to decrease while military attendance has been higher on average in more recent years than in earlier years. (Military attendance peaked at 19 students in the Class of 2001 and has declined slightly in following years, but the military to civilian ratios have remained high due to an even sharper decline in civilian attendance.) This has, of course, resulted in higher ratios of military to civilians on average in more recent classes.

As far as other data elements are concerned, military students have had only slightly higher average GMAT scores (545.7 vs. 537.2), and this difference is not statistically significant (T =

0.90, P = 0.37). Civilian students have had slightly higher undergraduate GPAs (3.143 vs. 3.02). This difference is also not statistically significant (T = 1.86, P = 0.065), though it is close to being so in the opposite direction than one would expect, in light of stronger military performance at Syracuse. Civilian students are, on average, roughly four years older than their military counterparts when attending Syracuse, and this is a statistically significant difference (T = 4.77, P = 0.0000); although reported years of military and/or government experience are similar with military students holding a slight edge (12.1 vs. 11.6) which is not statistically significant (T = 0.90, P = 0.37). Not surprisingly (due to greater opportunities to use educational benefits), military students have had (on average) greater exposure to previous graduate work than their civilian counterparts (12.4 vs. 2.8 average semester hours). This difference is statistically significant (T = 4.19, P = 0.0000). Civilians have held a slight edge on exposure to work related to the ACP/DCP curriculum (81.7% of civilians vs. 78% of military have had related undergraduate majors and/or prior graduate work), however, this difference is not statistically significant (T = 0.68, P = 0.50).

[42] In fact, the ACP/DCP environment is specifically structured to avoid, as much as possible, any distinctions between military and civilians during the program. All students wear civilian clothing during classes, and by tradition call each other by first name regardless of military rank or civilian grade. There is some perception that civilian students have a better financial arrangement than military (due to the civilians' receipt of partial per diem), but if anyone expected that to have an effect on performance, it would arguably have the opposite effect of what the models show (i.e., would tend to help civilians perform better than their military counterparts)!

[43] Just over half (50.5%) of the civilians have been single with no responsibility for dependents, while only 9.8% of the military have been in this status (this is statistically significant with T = 6.98 and P = 0.0000). Also, while 93.2% of the military students have been male, over half (51.6%) of the civilian students have been female (statistically significant with T = 7.92 and P = 0.0000). Finally, the proportion of civilians who have attended Syracuse in a geographic bachelor status has been over double that of their military counterparts (20.4% vs. 9.8%; also statistically significant with T = 2.14 and P = 0.034). This, of course, means that the majority of military students (80.4%) have had families with them during their time at Syracuse, while only 29.1% of civilian students have had families with them during that time.

[44] This stems from another difference between military and civilian ACP/DCP students. Military students receive an Academic Evaluation Report (AER), while civilians receive a performance report of the same format as if they were in an operational position. Of course, one could argue that differences in motivation due to this fact could have an environmental basis as well. The issue of whether military students consider their performance reports from Syracuse as more important to their careers (vs. those of their civilian counterparts) is beyond the scope of the present study, but could be an area for future research.

[45] In other words, much more highly significant than the standard 95% confidence interval (p = 0.05 or lower).

[46] Incidentally, this was true even during the preliminary research (described in an earlier note but not included here due to space limitations) that compared individual class year cohorts.

[47] The 99.9% confidence interval here is again much more highly significant than the standard 95% confidence interval. In terms of comparison, there are only two variables that are

more strongly correlated (positively) with Syracuse GPA in any of the models than is geographic bachelor status (negatively) in Model #5. In each of the models, GMAT score is by far the most strongly correlated (with $p=0.000$ in every case), while exact age at start of program also has $p=0.000$ in Model #2.

[48] One should note, however, that the stepwise regression for Model #5 does show these items as positively and negatively correlated, respectively, just not in a strong enough fashion to be included in the model.

[49] In fact, the stepwise regression for Model #5 suggests that military vs. civilian status is actually <u>negatively</u> correlated for the dual degree years, but not of sufficient significance to be included in the model.

[50] It is appropriate to point out here that the amount of prior graduate work completed is positively correlated to Syracuse GPA in the stepwise regressions for each model considered, though this factor was never significant enough to actually appear in any of the models themselves.

[51] Two further observations are appropriate here:

- During a conversation with the researcher in Fall 2004, Colonel Berg indicated anecdotally that one difference between students in the single degree ACP program and the double degree DCP program was that the ACP students complained about how hard it was, while the DCP students didn't even have enough time to complain!

- In fact, the accelerated nature of the program is a significant "selling point" for Syracuse from a cost-benefit perspective. As Syracuse is a private institution, some have argued that the Army could save money by sending more officers to public institutions (especially if they could qualify for in-state tuition) instead. However, the counter-argument (Syracuse's argument, if you will) is that the true greatest "cost" of the officer's education is the amount of time (measured at least in part in pay and benefits of the officer concerned) that the officer is away from a productive assignment. Therefore, if the ACP/DCP provides in 14 months the same, or greater, benefits that other programs take 24 months to produce, the true total cost to the Army is lower even after the Army pays the higher Syracuse tuition.

[52] See the ASA(FM&C) Web Page regarding the DCP, available at http://www.asafm.army. mil/proponency/POWBT/careerdevelopment/dcp.html; Internet; accessed 12 December 2005. The "Announcement of DCP for Civilian Employees" link from that page yields a memorandum that indicates (among other things) that civilians usually attend Syracuse in extended TDY status.

[53] Initially, the researcher was inclined to suggest that this study's findings regarding the impact of geographic bachelor status on performance might support a reconsideration of the policy for civilian attendance at Syracuse by at least providing the option of PCS vs. extended TDY. However, upon review of an earlier draft of this paper, both Colonel Berg and Ms. Placek commented that such a recommendation would not be appropriate for this study, since the primary focus here was on applicability of these results to the uniquely military ACS program. (David Berg, e-mail message to author, 28 February 2006; Terry Placek, e-mail message to author, 2 March 2006.)

As noted above, the models herein consider populations of both military and government civilian students, since they pursued the same programs based on similar eligibility criteria. However, while considering the comments from Colonel Berg and Ms. Placek, the researcher quickly created and reviewed statistical models as they might appear if they were run on only the military or civilian populations in this study as opposed to their consideration in combination as part of the same program. Interestingly, this review revealed that the impacts of some of the significant predictors of success are more pronounced among either military or civilian students.

GMAT score (as expected) remained the most significant predictor in every case. However, in general, the significances of age, pursuit of the double degree, and geographic bachelor status were more pronounced among military students than among their civilian counterparts; while the significance of undergraduate GPA was more pronounced among civilian students than among their military counterparts. Determining the reasons for such differences, if any, would be beyond the scope of the current study (though it might provide intriguing opportunities for further research). However, in light of the comments received and the fact that two of the most relevant findings in this study (the impacts of age and geographic bachelor status) stemmed from greater impacts on military students than their civilian counterparts, the researcher agreed that it was appropriate to forego any recommendation regarding the DCP civilian attendance policy as Colonel Berg and Ms. Placek suggested.

[54] AR 621-1, paragraph 2-14.a., requires ACS attendees to pursue at least a minimum full-time course load (as defined by the school they are attending) each term, while "completing their degree in the shortest time possible." One might argue that this implies an intent for each officer to take the heaviest course load possible consistent with degree goals. However, as a practical matter, the combination of the minimum course load requirement with the stated intent provides at least some ACS officers with some amount of flexibility regarding how quickly they complete their studies, a flexibility that their ACP/DCP counterparts have not had.

[55] The researcher recognizes, of course, that the potential impact on performance is not the only, and may not even be the primary, consideration for the Army or the student when making decisions regarding these issues. However, he believes that the evidence presented herein is significant enough to warrant at least some consideration regarding such decisions.

[56] These indicators of success include (roughly in order of significance) the following: GMAT score, undergraduate GPA, relationship of previous undergraduate and graduate work to proposed program, and number of years of Government and/or military experience. As mentioned in an earlier note, the amount of prior graduate work completed was also positively correlated to Syracuse GPA in the stepwise regressions for each model considered, though this factor was never significant enough to actually appear in any of the models themselves.